

**IN THE UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF DELAWARE**

ALTAIR LOGIX LLC,

Plaintiff,

v.

TEXAS INSTRUMENTS  
INCORPORATED,

Defendant.

C.A. No. 18-1065-MN

**DEFENDANT'S ORIGINAL ANSWER**

Defendant Texas Instruments Incorporated (“Defendant” or “TI”) submits its answer and defenses to Plaintiff Altair Logix LLC’s (“Plaintiff” or “Altair”) Original Complaint.

TI’s reproduction of the headings set forth in the Complaint is solely for the purpose of convenience and is not, and should not be construed as, an admission by TI that any allegation or other statements in the headings, whether explicit or implied, are true, correct, or admitted by TI. All allegations in Altair’s Complaint, including those in the headings, that TI does not expressly admit or deny in this Answer are specifically denied by TI.

**I. THE PARTIES**

1. Plaintiff Altair Logix LLC (“Altair Logix” or “Plaintiff”) is a Texas limited liability company with its principal place of business at 15922 Eldorado Pkwy, Suite 500 #1513, Frisco, TX 75035.

**TI’s Response:** TI is without knowledge or information sufficient to form a belief as to the truth of the allegations in paragraph 1 of the Complaint and therefore denies them.

2. On information and belief, Defendant Texas Instruments Incorporated (“Defendant”) is a corporation organized and existing under the laws of Delaware, with a place

of business at 12500 TI Blvd, Dallas, TX 75243. Defendant has a registered agent at The Corporation Trust Company, 1209 Orange St., Wilmington, DE 19801.

**TI's Response:** Admit.

## **II. JURISDICTION AND VENUE**

3. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has subject matter jurisdiction of such action under 28 U.S.C. §§ 1331 and 1338(a).

**TI's Response:** TI admits Altair's Complaint purports to allege claims for patent infringement under Title 35 of the United States Code, but TI expressly denies any liability for patent infringement. The question of subject matter jurisdiction is a conclusion of law, rather than a statement of fact, to which no response is required. To the extent a response is required, TI admits that this Court has subject matter jurisdiction over patent disputes arising under the patent laws of the United States.

4. On information and belief, Defendant is subject to this Court's specific and general personal jurisdiction, pursuant to due process and the Delaware Long-Arm Statute, due at least to its business in this forum, including at least a portion of the infringements alleged herein. Furthermore, Defendant is subject to this Court's specific and general personal jurisdiction because Defendant is a Delaware corporation.

**TI's Response:** TI admits it is subject to personal jurisdiction in the U.S. District Court for the District of Delaware, except that TI denies it has committed acts of patent infringement, induced acts of patent infringement by others, or contributed to patent infringement by others in this judicial district, the State of Delaware, or elsewhere in the United States.

5. Without limitation, on information and belief, within this state, Defendant has used the patented inventions thereby committing, and continuing to commit, acts of patent infringement alleged herein. In addition, on information and belief, Defendant has derived revenues from its infringing acts occurring within Delaware. Further, on information and belief, Defendant is subject to the Court's general jurisdiction, including from regularly doing or soliciting business, engaging in other persistent courses of conduct, and deriving substantial revenue from goods and services provided to persons or entities in Delaware. Further, on information and belief, Defendant is subject to the Court's personal jurisdiction at least due to its sale of products and/or services within Delaware. Defendant has committed such purposeful acts and/or transactions in Delaware such that it reasonably should know and expect that it could be haled into this Court as a consequence of such activity.

**TI's Response:** TI admits it is subject to personal jurisdiction in the U.S. District Court for the District of Delaware, except that TI denies it has committed acts of patent infringement, induced acts of patent infringement by others, or contributed to patent infringement by others in this judicial district, the State of Delaware, or elsewhere in the United States. TI denies all other allegations not expressly admitted.

6. Venue is proper in this district under 28 U.S.C. § 1400(b). On information and belief, Defendant is incorporated in Delaware. On information and belief, from and within this District Defendant has committed at least a portion of the infringements at issue in this case.

**TI's Response:** TI admits that venue is proper in the District of Delaware, except that TI denies it has committed acts of patent infringement, induced acts of patent infringement by others, or contributed to patent infringement by others in this judicial district, the State of Delaware, or elsewhere in the United States.

7. For these reasons, personal jurisdiction exists and venue is proper in this Court under 28 U.S.C. § 1400(b).

**TI's Response:** TI admits that personal jurisdiction and venue is proper in the District of Delaware, except that TI denies it has committed acts of patent infringement, induced acts of patent infringement by others, or contributed to patent infringement by others in this judicial district, the State of Delaware, or elsewhere in the United States. TI denies all other allegations not expressly admitted.

**III. COUNT I  
(PATENT INFRINGEMENT OF UNITED STATES PATENT NO. 6,289,434)**

8. Plaintiff incorporates the above paragraphs herein by reference.

**TI's Response:** This paragraph does not contain allegations for TI to either admit or deny. To the extent a response is required, TI denies the allegations contained in this paragraph.

9. On September 11, 2001, United States Patent No. 6,289,434 (“the ‘434 Patent”) was duly and legally issued by the United States Patent and Trademark Office. The application leading to the ‘434 patent was filed on February 27, 1998. (Ex. A at cover).

**TI's Response:** TI admits that a copy of the ’434 Patent is attached as Exhibit A to the Complaint and admits that, on its face, Exhibit A appears to be United States Patent No. 6,289,434, issued on by the United States Patent and Trademark Office on September 11, 2001 and filed on February 27, 1998. TI denies all other allegations not expressly admitted.

10. The ‘434 Patent is titled “Apparatus and Method of Implementing Systems on Silicon Using Dynamic-Adaptive Run-Time Reconfigurable Circuits for Processing Multiple,

Independent Data and Control Streams of Varying Rates.” A true and correct copy of the ‘434 Patent is attached hereto as Exhibit A and incorporated herein by reference.

**TI’s Response:** TI admits that a copy of the ’434 Patent is attached as Exhibit A to the Complaint and admits that, on its face, Exhibit A appears to be United States Patent No. 6,289,434, entitled “Apparatus and Method of Implementing Systems on Silicon Using Dynamic-Adaptive Run-Time Reconfigurable Circuits for Processing Multiple, Independent Data and Control Streams of Varying Rates.” TI denies all other allegations not expressly admitted.

11. Plaintiff is the assignee of all right, title and interest in the ‘434 patent, including all rights to enforce and prosecute actions for infringement and to collect damages for all relevant times against infringers of the ‘434 Patent. Accordingly, Plaintiff possesses the exclusive right and standing to prosecute the present action for infringement of the ‘434 Patent by Defendant.

**TI’s Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

12. The invention in the ‘434 Patent relates to the field of runtime reconfigurable dynamic-adaptive digital circuits which can implement a myriad of digital processing functions related to systems control, digital signal processing, communications, image processing, speech and voice recognition or synthesis, three-dimensional graphics rendering, and video processing. (Ex. A at col. 1:32-38). The object of the invention is to provide a new method and apparatus for implementing systems on silicon or other chip material which will enable the user a means for achieving the performance of fixed-function implementations at a lower cost. (*Id.* at col. 2:64 – col. 3:1).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

13. The most common method of implementing various functions on an integrated circuit is by specifically designing the function or functions to be performed by placing on silicon an interconnected group of digital circuits in a non-modifiable manner (hard-wired or fixed function implementation). (*Id.* at col. 1:42-47). These circuits are designed to provide the fastest possible operation of the circuit in the least amount of silicon area. (*Id.* at col. 1:47-49). In general, these circuits are made up of an interconnection of various amounts of random-access memory and logic circuits. (*Id.* at col. 1:49-51). Complex systems on silicon are broken up into separate blocks and each block is designed separately to only perform the function that it was intended to do. (*Id.* at col. 1:51-54). Each block has to be individually tested and validated, and then the whole system has to be tested to make sure that the constituent parts work together. (*Id.* at col. 1:54-56). This process is becoming increasingly complex as we move into future generations of single-chip system implementations. (*Id.* at col. 1:57-59). Systems implemented in this way generally tend to be the highest performing systems since each block in the system has been individually tuned to provide the expected level of performance. (*Id.* at col. 1:59-62). This method of implementation may be the smallest (cheapest in terms of silicon area) method when compared to three other distinct ways of implementing such systems. (*Id.* at col. 1:62-65). Each of the other three have their problems and generally do not tend to be the most cost- effective solution. (*Id.* at col. 1:65-67).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

14. The first way is implemented in software using a microprocessor and associated computing system, which can be used to functionally implement any system. (*Id.* at col. 2:1-2). However, such systems would not be able to deliver real-time performance in a cost-effective manner for the class of applications that was described above. (*Id.* at col. 2:3-5). Their use is best for modeling the subsequent hard-wired/fixed-function system before considerable design effort is put into the system design. (*Id.* at col. 2:5-8).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

15. The second way of implementing such systems is by using an ordinary digital signal processor (DSP). (*Id.* at col. 2:9-10). This class of computing machines is useful for real time processing of certain speech, audio, video and image processing problems and in certain control functions. (*Id.* at col. 2:10-13). However, they are not cost-effective when it comes to performing certain real time tasks which do not have a high degree of parallelism in them or tasks that require multiple parallel threads of operation such as three-dimensional graphics. (*Id.* at col. 2:13-17).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

16. The third way of implementing such systems is by using field programmable gate arrays (FPGA). (*Id.* at col. 2:18-19). These devices are made up of a two-dimensional array of fine grained logic and storage elements which can be connected together in the field by downloading a configuration stream which essentially routes signals between these elements. (*Id.* at col. 2:19-23). This routing of the data is performed by pass-transistor logic. (*Id.* at col. 2:24-25). FPGAs are by far the most flexible of the three methods mentioned. (*Id.* at col. 2:25-

26). The problem with trying to implement complex real-time systems with FPGAs is that although there is a greater flexibility for optimizing the silicon usage in such devices, the designer has to trade it off for increase in cost and decrease in performance. (*Id.* at col. 2:26-30). The performance may (in some cases) be increased considerably at a significant cost, but still would not match the performance of hard-wired fixed function devices. (*Id.* at col. 2:30-33).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

17. These three ways do not reduce the cost or increase the performance over fixed-function systems. (*Id.* at col. 2:35-37). In terms of performance, fixed-function systems still outperform the three ways for the same cost. (*Id.* at col. 2:37-39).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

18. The three systems can theoretically reduce cost by removing redundancy from the system. (*Id.* at col. 2:40-41). Redundancy is removed by re-using computational blocks and memory. (*Id.* at col. 2:41-42). The only problem is that these systems themselves are increasingly complex, and therefore, their computational density when compared with fixed-function devices is very high. (*Id.* at col. 2:42-45).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

19. Most systems on silicon are built up of complex blocks of functions that have varying data bandwidth and computational requirements. (*Id.* at col. 2:46-48). As data and control information moves through the system, the processing bandwidth varies enormously.

(*Id.* at col. 2:48-50). Regardless of the fact that the bandwidth varies, fixed-function systems have logic blocks that exhibit a “temporal redundancy” that can be exploited to drastically reduce the cost of the system. (*Id.* at col. 2:50-53). This is true, because in fixed function implementations all possible functional requirements of the necessary data processing must be implemented on the silicon regardless of the final application of the device or the nature of the data to be processed. (*Id.* at col. 2:53-57). Therefore, if a fixed function device must adaptively process data, then it must commit silicon resources to process all possible flavors of the data. (*Id.* at col. 2:58-60). Furthermore, state-variable storage in all fixed function systems are implemented using area inefficient storage elements such as latches and flip-flops. (*Id.* at col. 2:60-63).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

20. The inventors therefore sought to provide a new apparatus for implementing systems on a chip that will enable the user to achieve performance of fixed-function implementation at a lower cost. (*Id.* at col. 2:64 – col. 3:1). The lower cost is achieved by removing redundancy from the system. (*Id.* at col. 3:1-2). The redundancy is removed by re-using groups of computational and storage elements in different configurations. (*Id.* at col. 3:2-4). The cost is further reduced by employing only static or dynamic ram as a means for holding the state of the system. (*Id.* at col. 3:4-6). This invention provides a way for effectively adapting the configuration of the circuit to varying input data and processing requirements. (*Id.* at col. 3:6-8). All of this reconfiguration can take place dynamically in run-time without any degradation of performance over fixed-function implementations. (*Id.* at col. 3:8-11).

**TI's Response:** TI lacks sufficient knowledge and information to admit or deny the allegations contained in this paragraph and therefore denies.

21. The present invention is therefore an apparatus for adaptively dynamically reconfiguring groups of computations and storage elements in run-time to process multiple separate streams of data and control at varying rates. (*Id.* at col. 3:14-18). The ‘434 patent refers to the aggregate of the dynamically reconfigurable computational and storage elements as a “media processing unit.”

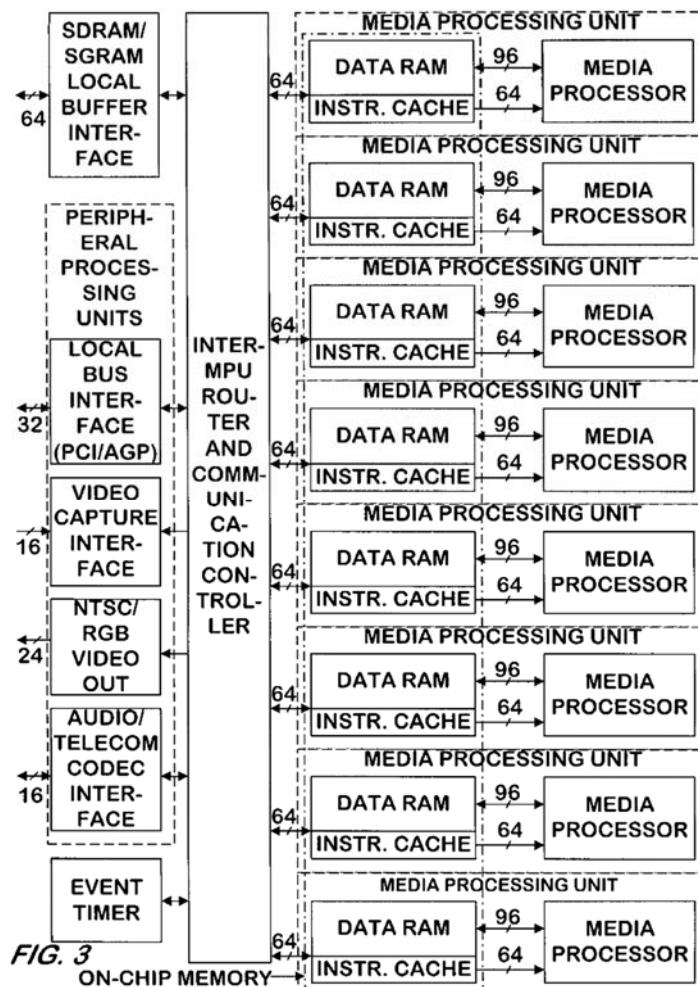
**TI’s Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

22. The claimed apparatus has addressable memory for storing data and a plurality of instructions that can be provided through a plurality of inputs/outputs that is couple to the input/output of a plurality of media processing units. (*Id.* at col. 55:21-30). The media processing unit comprises a multiplier, an arithmetic unit, and arithmetic logic unit and a bit manipulation unit. (*Id.* at col. 55:31 – col. 56:20). The ‘434 patent provides examples to explain each of the parts of the media processing unit. (*Id.* at col. 16:27-61 (multiplier and adder); *id.* at col. 16:62 – col. 17:1-9 (arithmetic logic unit); and *id.* at col. 17:10 – col. 17:43 (bit manipulation unit)). Each of the parts has a data input coupled to the media processing unit input/output, an instruction input coupled to the mediate processing unit input/output, and a data output coupled to the mediate processing unit input/output. (*Id.* at col. 55:31 – col. 56:20). Furthermore, the arithmetic logic unit must be capable of operating concurrently with either the multiplier and arithmetic unit. (*Id.* at col. 56:6-12). And the bit manipulation unit must be capable of operating concurrently with the arithmetic logic unit and at least either the multiplier or the arithmetic unit. (*Id.* at col. 56:13-20). Each of the plurality of media processing units must be capable of performing an operating simultaneously with the performance of other operations by other media

processing units. (*Id.* at col. 56:21-24). An operation comprises the media processing unit receiving an instruction and data from memory, processing the data responsive to the instruction to produce a result, and providing the result to the media processor input/output. (*Id.* at col. 56:26-33).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

23. An exemplary block diagram of the claimed systems is shown in Figure 3 of the '434 patent:



(*Id.* at Fig. 3). Exemplary architecture and coding for the apparatus is disclosed in the ‘599 patent. (*E.g.*, *id.* at col. 16:15 – col. 52:20; Figs. 9 – 106).

**TI’s Response:** TI admits the figure depicted in this paragraph appears to be a reproduction of Figure 3 of the ‘434 Patent. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

24. As further demonstrated by the prosecution history of the ‘434 patent, the claimed invention in the ‘434 patent was unconventional. Claim 1 of the ‘434 patent was an originally filed claim that issued without any amendment. There was no rejection in the prosecution history contending that claim 1 was anticipated by any prior art.

**TI’s Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

25. A key element behind the invention is one of reconfigurability and reusability. (*Id.* at col. 13:26-27). Each apparatus is therefore made up of very high-speed core elements that on a pipelined basis can be configured to form a more complex function. (*Id.* at col. 13:27-30). This leads to a lower gate count, thereby giving a smaller die size and ultimately a lower cost. (*Id.* at col. 13:30-31). Since the apparatuses are virtually identical to each other, writing software becomes very easy. (*Id.* at col. 13:32-33). The RISC-like nature of each of the media processing units also allows for a consistent hardware platform for simple operating system and driver development. (*Id.* at col. 13:33-36). Any one of the media processing units can take on a supervisory role and act as a central controller if necessary. (*Id.* at col. 13:36-37). This can be very useful in set top applications where a controlling CPU may not be necessary, further reducing system cost. (*Id.* at col. 13:37-40). The claimed apparatus is therefore an unconventional way

of implementing processors that can achieve the performance of fixed-function implementations at a lower cost. (*Id.* at col. 2:64 – col. 3:11).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

26. **Direct Infringement.** Upon information and belief, Defendant has been directly infringing claim of the '434 patent in Delaware, and elsewhere in the United States, by making, using, selling, and offering for sale an apparatus for processing data for media processing that satisfies each and every limitation of claim 1, including without limitation the Texas Instruments 66AK2Hxx Multicore DSP+ARM® KeyStone II System-on-Chip (“Accused Instrumentality”). (E.g., <http://www.ti.com/lit/ds/symlink/66ak2h14.pdf>).

**TI's Response:** Denied.

27. The Accused Instrumentality comprises an addressable memory (e.g., memory system of the accused product) for storing the data, and a plurality of instructions, and having a plurality of input/outputs, each said input/output for providing and receiving at least one selected from the data and the instructions. As shown below, the accused product comprises a memory system which is coupled to multicore ARM processors through multiple internal inputs/outputs. The memory system provides instructions and stored data for processing and receives processed data.

### 1.1 Features

- Eight TMS320C66x DSP Core Subsystems (C66x CorePacs), Each With
  - 1.0 GHz or 1.2 GHz C66x Fixed- and Floating-Point DSP Core
    - 38.4 GMacs/Core for Fixed Point @ 1.2 GHz
    - 19.2 GFlops/Core for Floating Point @ 1.2 GHz
  - Memory
    - 32-KB L1P Per CorePac
    - 32-KB L1D Per CorePac
    - 1024-KB Local L2 Per CorePac
- ARM CorePac
  - Four ARM® Cortex®-A15 MPCore™ Processors at up to 1.4 GHz
  - 4MB of L2 Cache Memory Shared by Four ARM Cores
  - Full Implementation of ARMv7-A Architecture Instruction Set
  - 32-KB L1 Instruction and Data Caches per Core
  - AMBA 4.0 AXI Coherency Extension (ACE) Master Port, Connected to MSMC for Low-Latency Access to Shared MSMC SRAM
- Multicore Shared Memory Controller (MSMC)
  - 6MB of MSM SRAM Memory Shared by Eight DSP CorePacs and One ARM CorePac
  - Memory Protection Unit (MPU) for Both MSM SRAM and DDR3\_EMIF

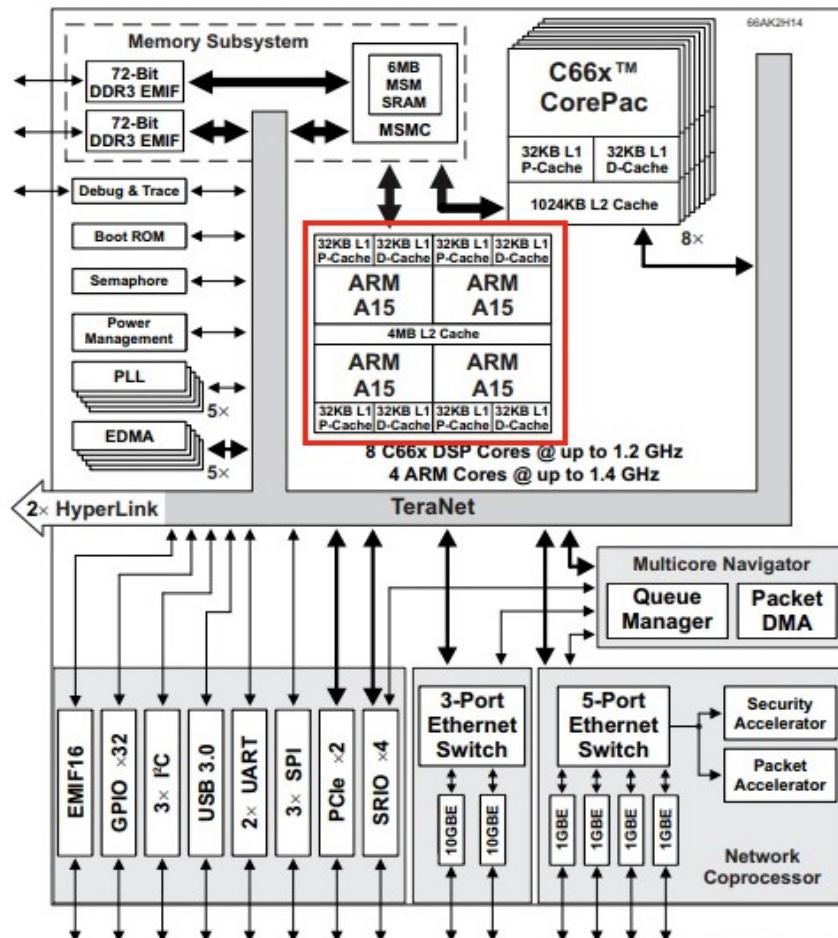
The key features of the Quad Core ARM CorePac are as follows:

- One or more Cortex-A15 processors, each containing:
  - Cortex-A15 processor revision R2P4.
  - ARM architecture version 7 ISA.
  - Multi-issue, out-of-order, superscalar pipeline.
  - L1 and L2 instruction and data cache of 32KB, 2-way, 16 word line with 128-bit interface.
  - Integrated L2 cache of 4MB, 16-way, 16-word line, 128-bit interface to L1 along with ECC/parity.
  - Includes the NEON™ media coprocessor (NEON), which implements the advanced SIMDv2 media processing architecture and the VFPv4 Vector Floating Point architecture.
  - The external interface uses the AXI protocol configured to 128-bit data width.
  - Includes the System Trace Macrocell (STM) support for noninvasive debugging.
  - Implements the ARMv7 debug with watchpoint and breakpoint registers and 32-bit advanced peripheral bus (APB) slave interface to CoreSight™ debug systems.
- Interrupt controller
  - Supports up to 480 interrupt requests
- Emulation/debug
  - Compatible with CoreSight architecture

(E.g., <http://www.ti.com/lit/ds/symlink/66ak2h14.pdf>).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

28. The accused product comprises a plurality of media processing units (*e.g.*, ARM cortex- A15 multicore processors), each media processing unit having an input/output coupled to at least one of the addressable memory input/outputs. As shown below, the accused product comprises ARM cortex- A15 multicore processors, each processor comprises a NEON media coprocessor and acts as a media processing unit. The ARM processors are coupled to the memory system. The processors receive instructions and data from the memory system by multiple internal inputs and provides processed data to the memory system by multiple internal outputs.



## ARM Cortex-A15 Processor

### Overview

The ARM Cortex-A15 processor incorporates the technologies available in the ARM7™ architecture. These technologies include NEON for media and signal processing and Jazelle® RCT for acceleration of real-time compilers, Thumb®-2 technology for code density, and the VFPv4 floating point architecture. For details, see the ARM Cortex-A15 Processor Technical Reference Manual.

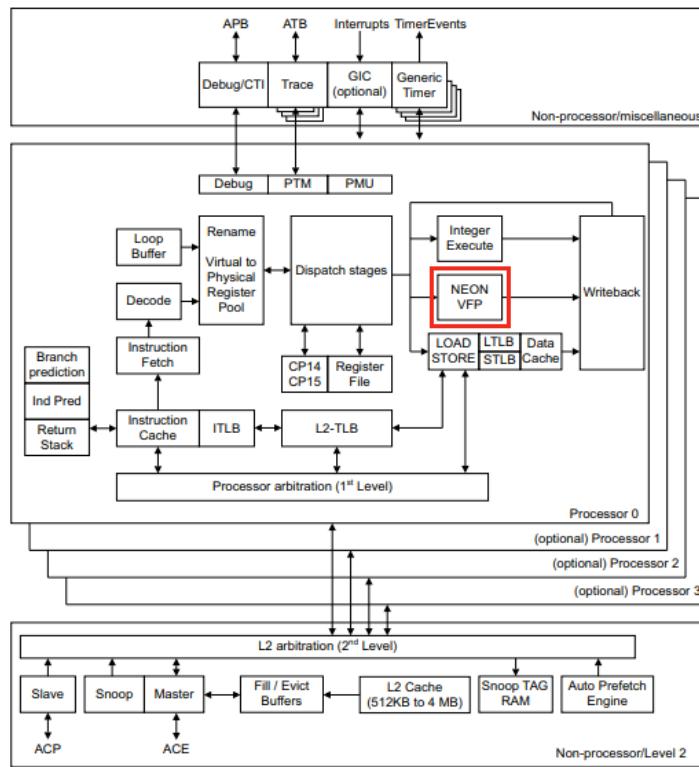
### Features

The key features of the Quad Core ARM CorePac are as follows:

- One or more Cortex-A15 processors, each containing:
  - Cortex-A15 processor revision R2P4.
  - ARM architecture version 7 ISA.
  - Multi-issue, out-of-order, superscalar pipeline.
  - L1 and L2 instruction and data cache of 32KB, 2-way, 16 word line with 128-bit interface.
  - Integrated L2 cache of 4MB, 16-way, 16-word line, 128-bit interface to L1 along with ECC/parity.
  - Includes the NEON™ media coprocessor (NEON), which implements the advanced SIMDv2 media processing architecture and the VFPv4 Vector Floating Point architecture.
  - The external interface uses the AXI protocol configured to 128-bit data width.
  - Includes the System Trace Macrocell (STM) support for noninvasive debugging.
  - Implements the ARMv7 debug with watchpoint and breakpoint registers and 32-bit advanced peripheral bus (APB) slave interface to CoreSight™ debug systems.
- Interrupt controller
  - Supports up to 480 interrupt requests
- Emulation/debug
  - Compatible with CoreSight architecture

(E.g., <http://www.ti.com/lit/ds/symlink/66ak2h14.pdf>).

Figure 2-1 shows a block diagram of the Cortex-A15 processor.

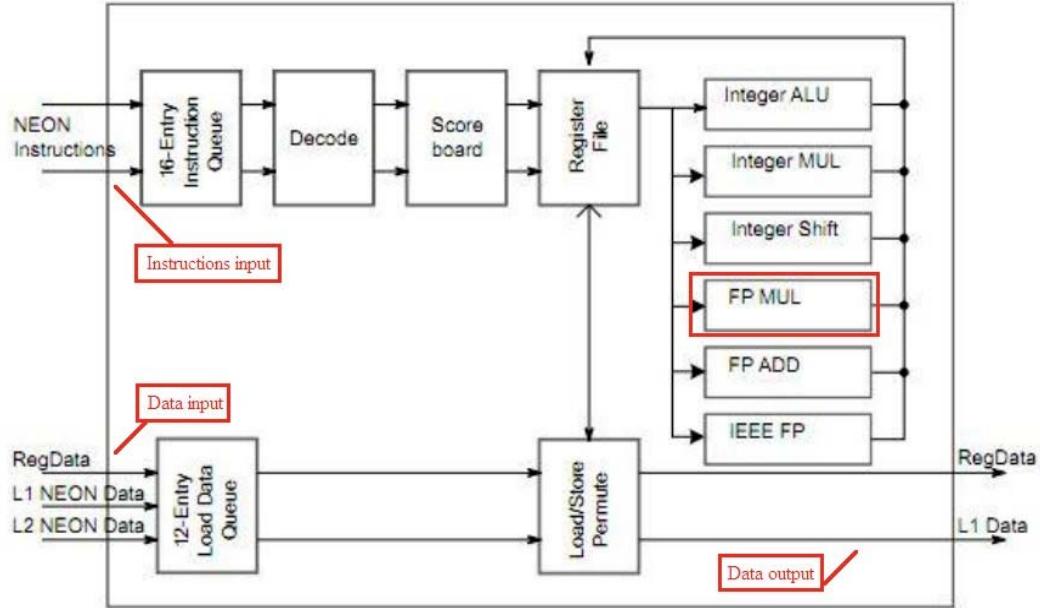


(*E.g.*,

[http://infocenter.arm.com/help/topic/com.arm.doc.ddi0438c/DDI0438C\\_cortex\\_a15\\_r2p0\\_trm.pdf](http://infocenter.arm.com/help/topic/com.arm.doc.ddi0438c/DDI0438C_cortex_a15_r2p0_trm.pdf).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors with NEON media coprocessors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

29. The accused product comprises media processors with each processor comprising a multiplier (*e.g.*, an Integer MUL or FP MUL) having a data input coupled to the media processing unit input/output, an instruction input coupled to the media processing unit input/output, and a data output coupled to the media processing unit input/output. As shown below, the accused product comprises multiple ARM cortex- A15 multicore processor, each processor comprises a NEON media coprocessor and acts as a media processing unit. NEON media coprocessor comprises a multiplier which is coupled to the inputs/outputs of the processor. Upon information and belief, the multiplier comprises a data input, an instruction input, and a data output coupled to the input/output of the processor.



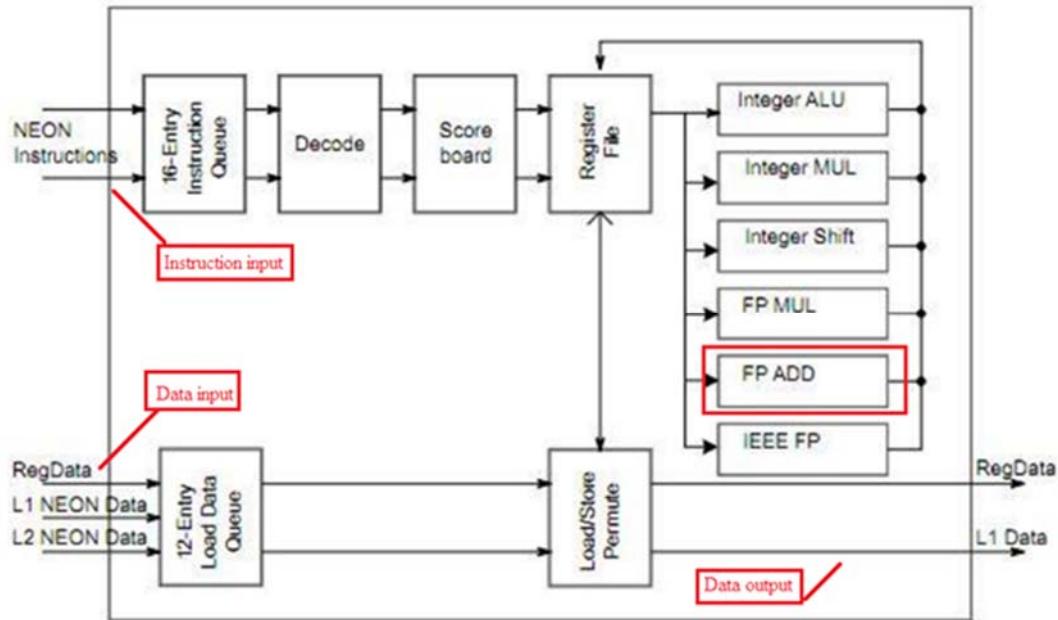
(E.g.,

<http://www.add.ece.ufl.edu/4924/docs/arm/ARM%20NEON%20Development.pdf>).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors with NEON media coprocessors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

30. The accused product comprises media processors with each processor comprising an arithmetic unit (e.g. an FP ADD) having a data input coupled to the media processing unit input/output, an instruction input coupled to the media processing unit input/output, and a data output coupled to the media processing unit input/output. As shown below, the accused product comprises multiple ARM cortex- A15 multicore processor, each processor comprises a NEON media coprocessor and acts as a media processing unit. NEON media coprocessor comprises an arithmetic unit which is coupled to the inputs/outputs of the processor. Upon information and

belief, the arithmetic unit comprises a data input, an instruction input, and a data output coupled to the input/output of the processor.

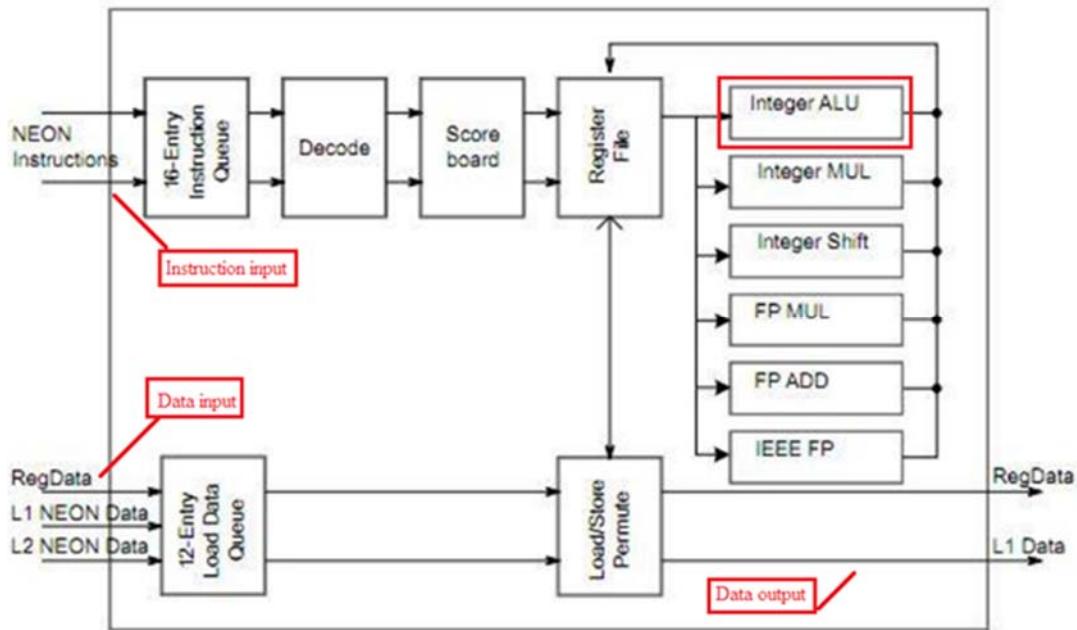


(E.g., <http://www.add.ece.ufl.edu/4924/docs/arm/ARM%20NEON%20Development.pdf>).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors with NEON media coprocessors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

31. The accused product comprises media processors with each processor comprising an arithmetic logic unit (e.g. an ALU) having a data input coupled to the media processing unit input/output, an instruction input coupled to the media processing unit input/output, and a data output coupled to the media processing unit input/output, capable of operating concurrently with at least one selected from the multiplier (e.g. an Integer MUL or FP MUL) and arithmetic unit (e.g. a FP ADD). As shown below, the accused product comprises multiple ARM cortex- A15

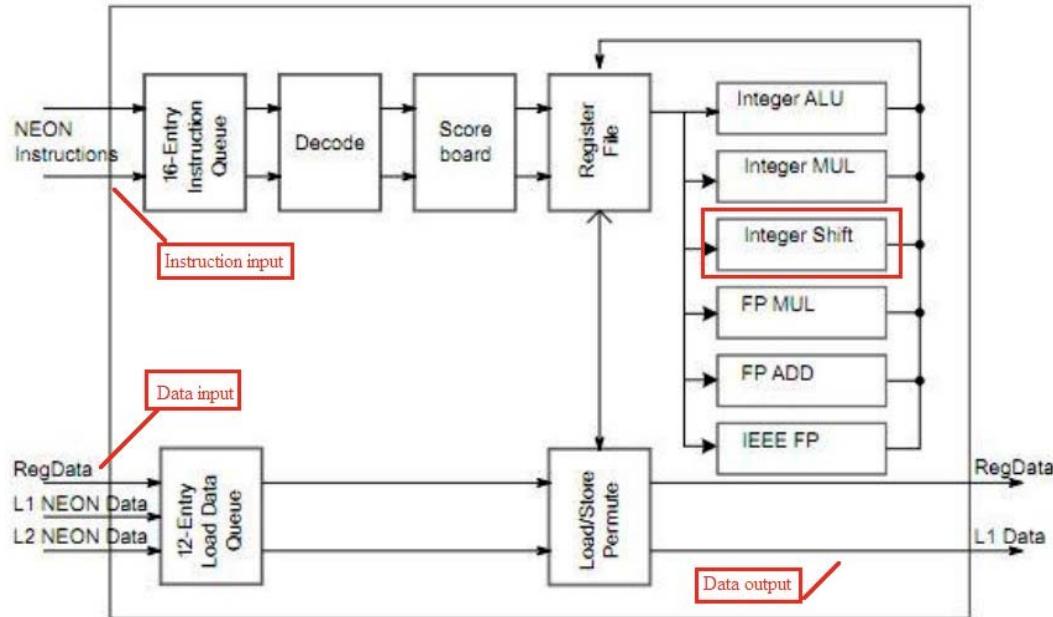
multicore processor, each processor comprises a NEON media coprocessor and acts as a media processing unit. NEON media coprocessor comprises an arithmetic logical unit which is coupled to the inputs/outputs of the processor. Upon information and belief, the arithmetic logical unit comprises a data input, an instruction input, and a data output coupled to the input/output of the processor. Upon information and belief, the arithmetic logical unit (e.g. the Integer ALU) is capable of operating concurrently with at least one selected from the multiplier (e.g. the Integer MUL or FP MUL) and arithmetic unit (e.g. the FP ADD).



(E.g., <http://www.add.ece.ufl.edu/4924/docs/arm/ARM%20NEON%20Development.pdf>).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors with NEON media coprocessors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

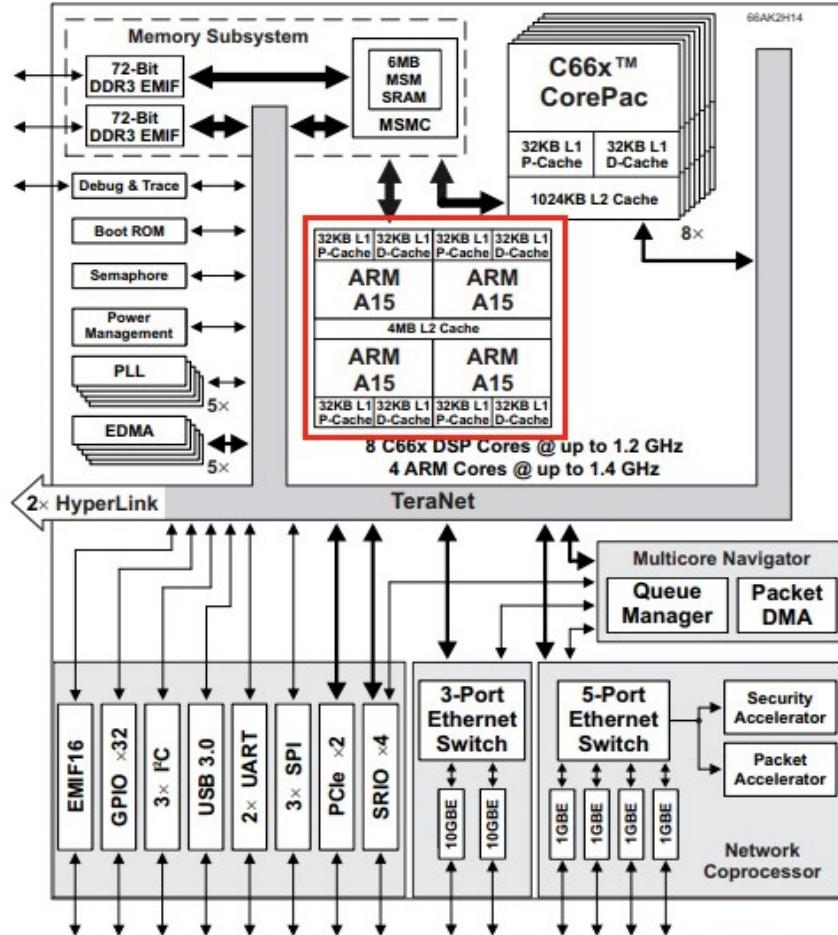
32. The accused product comprises media processors with each processor comprising a bit manipulation unit (e.g., an Integer Shift unit) having a data input coupled to the media processing unit input/output, an instruction input coupled to the media processing unit input/output, and a data output coupled to the media processing unit input/output, capable of operating concurrently with the arithmetic logic unit (e.g. an Integer ALU) and at least one selected from the multiplier (e.g. an Integer MUL or FP MUL) and arithmetic unit (e.g. a FP ADD). As shown below, the accused product comprises multiple ARM cortex- A15 multicore processors, each processor comprising a NEON media coprocessor that acts as a media processing unit. The NEON media coprocessor comprises an integer shift unit (i.e., bit manipulation unit) which is coupled to the inputs/outputs of the processor. Upon information and belief, the integer shift unit (i.e. bit manipulation unit) comprises a data input, an instruction input, and a data output coupled to the input/output of the processor. Upon information and belief, the integer shift unit (i.e. bit manipulation unit) is capable of operating concurrently with the arithmetic logic unit (e.g. the Integer ALU) and at least one selected from the multiplier (e.g. the Integer MUL or FP MUL) and arithmetic unit (e.g. the FP ADD).



(E.g., <http://www.add.ece.ufl.edu/4924/docs/arm/ARM%20NEON%20Development.pdf>).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors with NEON media coprocessors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

33. The accused product comprises a plurality of media processors (e.g., ARM cortex-A15 multicore processors) for performing at least one operation, simultaneously with the performance of other operations by other media processing units (e.g., other ARM cortex- A15 multicore processors on the same chip).



### ARM Cortex-A15 Processor

#### Overview

The ARM Cortex-A15 processor incorporates the technologies available in the ARM7™ architecture. These technologies include NEON for media and signal processing and Jazelle® RCT for acceleration of real-time compilers, Thumb®-2 technology for code density, and the VFPv4 floating point architecture. For details, see the ARM Cortex-A15 Processor Technical Reference Manual.

### Features

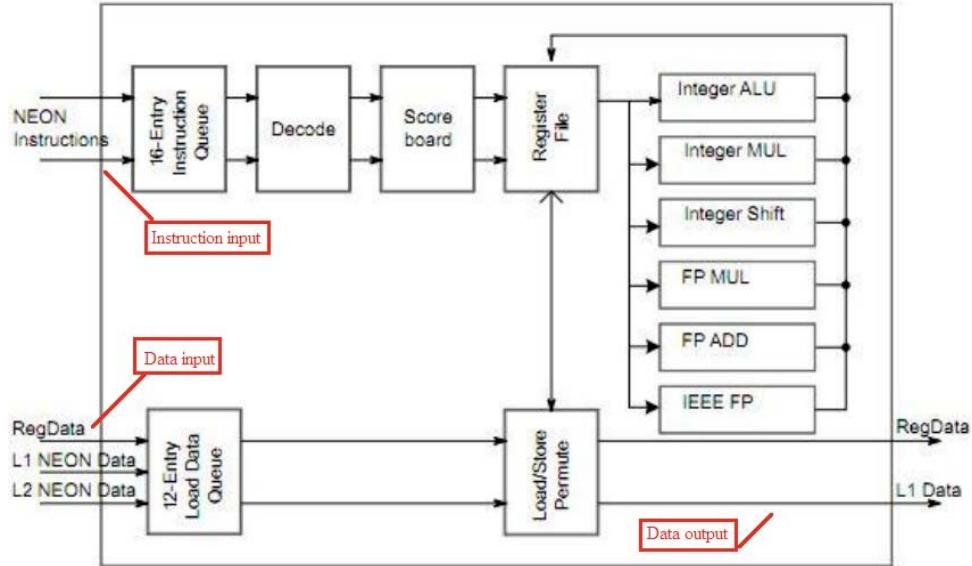
The key features of the Quad Core ARM CorePac are as follows:

- One or more Cortex-A15 processors, each containing:
  - Cortex-A15 processor revision R2P4.
  - ARM architecture version 7 ISA.
  - Multi-issue, out-of-order, superscalar pipeline.
  - L1 and L2 instruction and data cache of 32KB, 2-way, 16 word line with 128-bit interface.
  - Integrated L2 cache of 4MB, 16-way, 16-word line, 128-bit interface to L1 along with ECC/parity.
  - Includes the NEON™ media coprocessor (NEON), which implements the advanced SIMDv2 media processing architecture and the VFPv4 Vector Floating Point architecture.
  - The external interface uses the AXI protocol configured to 128-bit data width.
  - Includes the System Trace Macrocell (STM) support for noninvasive debugging.
  - Implements the ARMv7 debug with watchpoint and breakpoint registers and 32-bit advanced peripheral bus (APB) slave interface to CoreSight™ debug systems.
- Interrupt controller
  - Supports up to 480 interrupt requests
- Emulation/debug
  - Compatible with CoreSight architecture

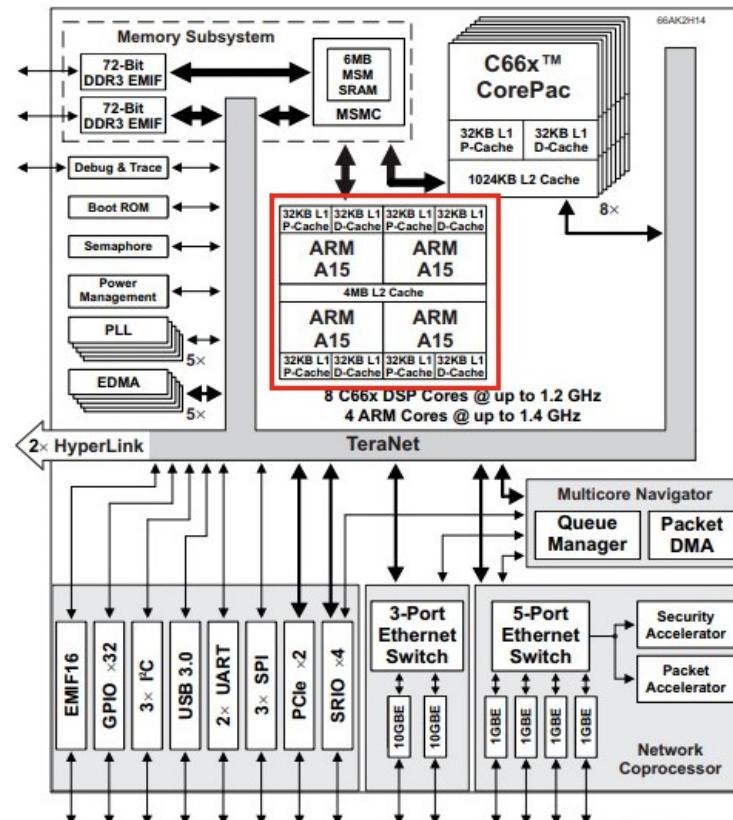
(*E.g.*, <http://www.ti.com/lit/ds/symlink/66ak2h14.pdf>).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors with NEON media coprocessors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

34. The accused product comprises a plurality of media processors (*e.g.*, ARM cortex-A15 multicore processors), each processor receiving at the media processor input/output an instruction and data from the memory, and processing the data responsive to the instruction received to produce at least one result. As shown below, each ARM cortex- A15 multicore media processor comprises a NEON media coprocessor which receives instructions and data from memory and processes the data responsive to the instruction received in order to produce a result.



(E.g., <http://www.add.ece.ufl.edu/4924/docs/arm/ARM%20NEON%20Development.pdf>).



### 1.1 Features

- Eight TMS320C66x DSP Core Subsystems (C66x CorePacs), Each With
  - 1.0 GHz or 1.2 GHz C66x Fixed- and Floating-Point DSP Core
    - 38.4 GMacs/Core for Fixed Point @ 1.2 GHz
    - 19.2 GFlops/Core for Floating Point @ 1.2 GHz
  - Memory
    - 32-KB L1P Per CorePac
    - 32-KB L1D Per CorePac
    - 1024-KB Local L2 Per CorePac
- ARM CorePac
  - Four ARM® Cortex®-A15 MPCore™ Processors at up to 1.4 GHz
  - 4MB of L2 Cache Memory Shared by Four ARM Cores
  - Full Implementation of ARMv7-A Architecture Instruction Set
  - 32-KB L1 Instruction and Data Caches per Core
  - AMBA 4.0 AXI Coherency Extension (ACE) Master Port, Connected to MSMC for Low-Latency Access to Shared MSMC SRAM
- Multicore Shared Memory Controller (MSMC)
  - 6MB of MSM SRAM Memory Shared by Eight DSP CorePacs and One ARM CorePac
  - Memory Protection Unit (MPU) for Both MSM SRAM and DDR3\_EMIF

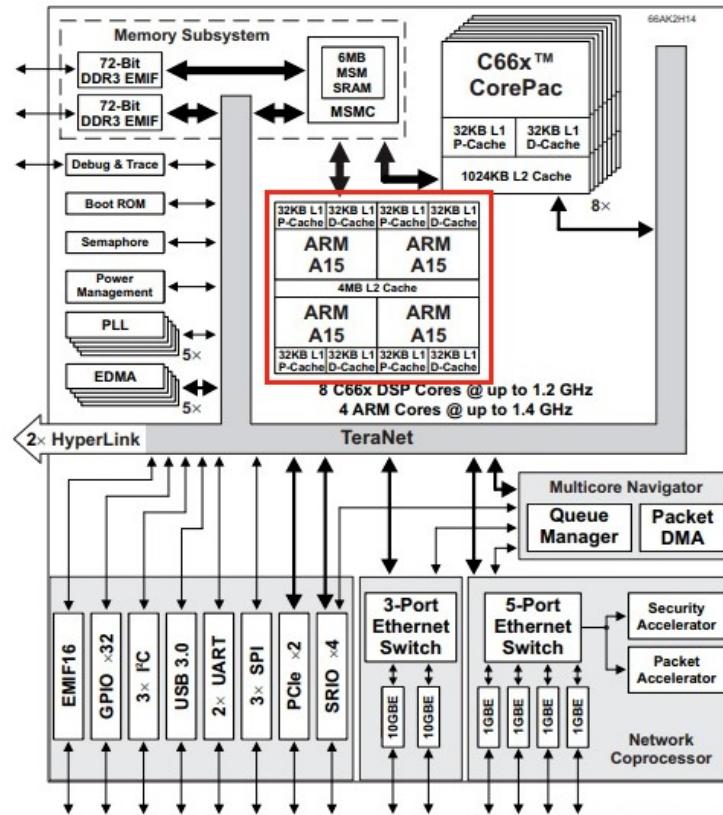
The key features of the Quad Core ARM CorePac are as follows:

- One or more Cortex-A15 processors, each containing:
  - Cortex-A15 processor revision R2P4.
  - ARM architecture version 7 ISA.
  - Multi-issue, out-of-order, superscalar pipeline.
  - L1 and L2 instruction and data cache of 32KB, 2-way, 16 word line with 128-bit interface.
  - Integrated L2 cache of 4MB, 16-way, 16-word line, 128-bit interface to L1 along with ECC/parity.
  - Includes the NEON™ media coprocessor (NEON), which implements the advanced SIMDv2 media processing architecture and the VFPv4 Vector Floating Point architecture.
  - The external interface uses the AXI protocol configured to 128-bit data width.
  - Includes the System Trace Macrocell (STM) support for noninvasive debugging.
  - Implements the ARMv7 debug with watchpoint and breakpoint registers and 32-bit advanced peripheral bus (APB) slave interface to CoreSight™ debug systems.
- Interrupt controller
  - Supports up to 480 interrupt requests
- Emulation/debug
  - Compatible with CoreSight architecture

(E.g., <http://www.ti.com/lit/ds/symlink/66ak2h14.pdf>).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors with NEON media coprocessors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

35. The accused product comprises a plurality of media processors (*e.g.*, ARM cortex-A15 multicore processors), each processor providing at least one of the at least one result at the media processor input/output.



## ARM Cortex-A15 Processor

### Overview

The ARM Cortex-A15 processor incorporates the technologies available in the ARM<sup>TM</sup> architecture. These technologies include NEON for media and signal processing and Jazelle<sup>®</sup> RCT for acceleration of real-time compilers, Thumb<sup>®</sup>-2 technology for code density, and the VFPv4 floating point architecture. For details, see the ARM Cortex-A15 Processor Technical Reference Manual.

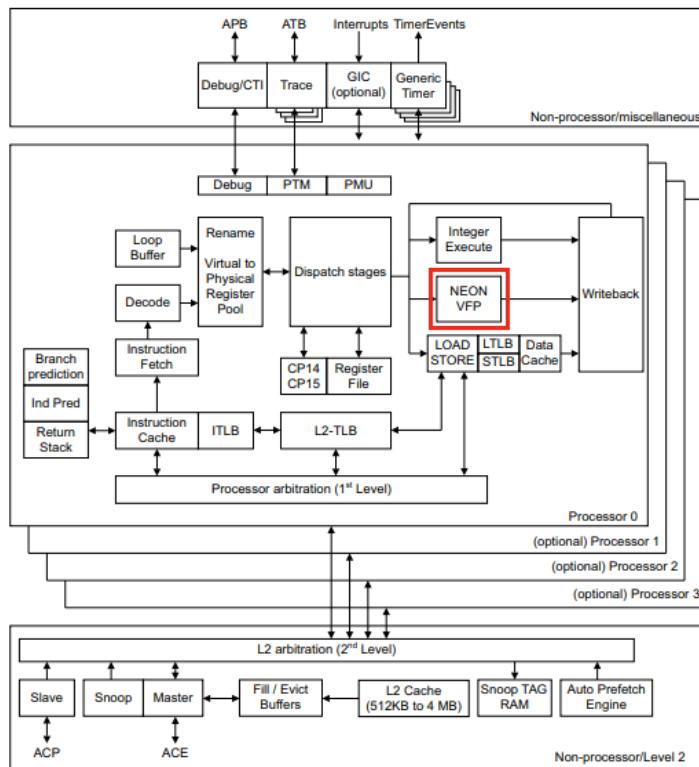
### Features

The key features of the Quad Core ARM CorePac are as follows:

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  - Cortex-A15 processor revision R2P4.
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- Interrupt controller
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(E.g., <http://www.ti.com/lit/ds/symlink/66ak2h14.pdf>).

Figure 2-1 shows a block diagram of the Cortex-A15 processor.



(E.g.,

[http://infocenter.arm.com/help/topic/com.arm.doc.ddi0438c/DDI0438C\\_cortex\\_a15\\_r2p0\\_trm.pdf](http://infocenter.arm.com/help/topic/com.arm.doc.ddi0438c/DDI0438C_cortex_a15_r2p0_trm.pdf).

**TI's Response:** This paragraph states, in part, a legal conclusion to which no response is required. TI admits that the TI 66AK2Hxx product contains four ARM cortex A15 processors. TI lacks sufficient knowledge and information to admit or deny the remaining allegations contained in this paragraph and therefore denies.

36. Plaintiff has been damaged as a result of Defendant's infringing conduct. Defendant is thus liable to Plaintiff for damages in an amount that adequately compensates Plaintiff for such Defendant's infringement of the '434 patent, *i.e.*, in an amount that by law cannot be less than would constitute a reasonable royalty for the use of the patented technology, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

**TI's Response:** Denied.

37. On information and belief, Defendant has had at least constructive notice of the '434 patent by operation of law, and there are no marking requirements that have not been complied with.

**TI's Response:** Denied.

#### **IV. JURY DEMAND**

Plaintiff, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

**TI's Response:** No response to Demand for Jury Trial is necessary. To the extent a response is required, TI denies any allegations contained in the Demand for Jury Trial, and denies that Altair is entitled to any of the requested relief.

## **V. PRAYER FOR RELIEF**

WHEREFORE, Plaintiff respectfully requests that the Court find in its favor and against Defendant, and that the Court grant Plaintiff the following relief:

- a. Judgment that one or more claims of United States Patent No. 6,289,434 have been infringed, either literally and/or under the doctrine of equivalents, by Defendant;
- b. Judgment that Defendant account for and pay to Plaintiff all damages to and costs incurred by Plaintiff because of Defendant's infringing activities and other conduct complained of herein;
- c. That Plaintiff be granted pre-judgment and post-judgment interest on the damages caused by Defendant's infringing activities and other conduct complained of herein; and
- d. That Plaintiff be granted such other and further relief as the Court may deem just and proper under the circumstances.

**TI's Response:** No response to the Prayer for Relief is necessary. To the extent a response is required, TI denies that Altair is entitled to any of the requested relief against TI.

## **VI. DEFENSES**

TI asserts the following defenses to Altair's claims without admitting or acknowledging that it bears the burden of proof as to any of the defenses asserted. TI reserves the right to amend its Answer to add additional Defenses.

### **FIRST DEFENSE: NON-INFRINGEMENT**

38. TI does not infringe and has never infringed any valid and enforceable claim of the Patent-In-Suit, as defined in Altair's Complaint, whether literally, directly, indirectly, jointly with any other person or entity, contributorily, by inducement, under the doctrine of equivalents, or otherwise under any section of 35 U.S.C. § 271, and as such, is without any liability to Altair.

**SECOND DEFENSE: INVALIDITY**

39. The asserted claim of the Patent-In-Suit is invalid for failure to comply with the requirements of the patent laws of the United States, including provisions of 35 U.S.C. §§ 101, 102, 103, or 112.

**THIRD DEFENSE: LIMITATION ON DAMAGES**

40. Any recovery of damages by Altair is limited in whole or in part by 35 U.S.C. §§ 286, 287, and/or 288.

**FOURTH DEFENSE: EQUITABLE DEFENSES**

41. Altair's claims for relief concerning the Patent-In-Suit are barred, in whole or in part, under the principles of equity, estoppel, prosecution history estoppel and/or disclaimer, and/or unclean hands.

**FIFTH DEFENSE: LICENSE DEFENSE**

42. Altair's claims for patent infringement are precluded in whole or in part (i) to the extent that any allegedly infringing products or components thereof are supplied, directly or indirectly, to TI or are imported, sold by, offered for sale by, made by, or made for, any entity or entities having express or implied licenses to the Patent-in-Suit and/or (2) under the doctrine of patent exhaustion.

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*Attorneys for Defendant Texas  
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Dated: April 23, 2019